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Title: Continuous Flow Biocatalytic Generation of Green Propellant Fuels

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TITLE: “Continuous Flow Biocatalytic Generation of Green Propellant Fuels”
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ABSTRACT FOR UC LAB FEES:

Propulsion technologies have focused on monopropellant hydrazine systems for the past four decades. However, hydrazine is both highly toxic and highly flammable, requiring expensive cold storage and specialized handling and disposal protocols. Alternative propellant fuels for supporting satellites and spacecraft are required, and greener, on-demand approaches for manufacturing denser, less dangerous rocket fuels are essential.

This project will ensure that humans in extreme environments such as space can sustainably access renewable fuel resources from biomass waste streams *via* continuous biocatalytic manufacturing using microfluidic reactor systems. Demonstration of our sustainable and recyclable processes for manufacturing greener propellants from biomass waste will advance further applications in future space missions.

There remains a continued need to develop more sustainable, environmentally-responsible pathways for manufacturing fuels in general and propellants in particular. This project, building upon known biocatalytic processes, will provide astronauts with renewable propellant fuel sources that can be manufactured *in situ*. Thus, “on-demand” access to propellants that perform more efficiently than hydrazine is enabled by this proposed work (TRL 2/3).

The scope of work for this project for Mr. Spano as a graduate student includes assembling the appropriate microreactor platform, immobilizing and assaying enzyme activity within the microreactor platform for each of the reaction steps, and then combining/“telescoping” all steps for fuel manufacturing as a small scale continuous process to produce flight stable products/precursors. The advantages of performing entire syntheses as automated, self-contained flow-through processes include ensuring reproducibility and safer containment in microgravity environments in addition to enabling “as needed” manufacturing capabilities. Each step of our processing paradigms will be monitored using inline characterization analytics that are correlated to offline real-time diagnostics for quality assurance. A significant component of this project to ensure further establishment of our technology will be internal national lab communication with a view toward follow-on funding between future sponsors (NASA, CASIS, DoD, DTRA), LANL Program Managers, and the PIs (national lab/UC). Mr. Spano will play an integral role in ensuring that this project generates significant progress from TRL 2/3 to TRL 4/5 and he will also participate in the further space implementation of this technology for adoption to microgravity environments.